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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/892,878	06/28/2001	Jun Dong Kim	08245.0027	3043

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EXAMINER

RAO, SHRINIVAS H

ART UNIT PAPER NUMBER

2814

DATE MAILED: 10/20/2004

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

09/892,878

Applicant(s)

KIM ET AL.

Examiner

Steven H. Rao

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 08 September 2004.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1,3,4 and 11-21 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☐ Claim(s) 1,3,4 and 11-21 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 09/082/004 is/are: a) ☒ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☒ All b) ☐ Some * c) ☐ None of:
1. ☒ Certified copies of the priority documents have been received.
 2. ☐ Certified copies of the priority documents have been received in Application No. _____.
 3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- * See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- | | |
|--|---|
| 1) <input type="checkbox"/> Notice of References Cited (PTO-892) | 4) <input type="checkbox"/> Interview Summary (PTO-413)
Paper No(s)/Mail Date. _____ |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | 5) <input type="checkbox"/> Notice of Informal Patent Application (PTO-152) |
| 3) <input type="checkbox"/> Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)
Paper No(s)/Mail Date _____ | 6) <input type="checkbox"/> Other: _____ |

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DETAILED ACTION

Priority

Receipt is acknowledged of paper submitted under 37 CFR 1.114 from U.S. Serial No. 09/ 892,878 filed on June 28, 2001 which itself claims priority under 35 U.S.C. 119(a)-(d), from Korean Patent Application No. 2000-36495 filed on June 29, 2000 which papers have been placed of record in the file.

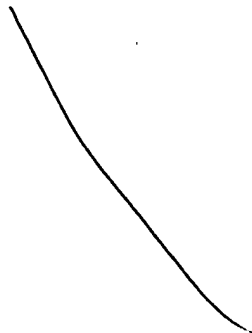
Continued Prosecution Application

The request filed on 9/8/2004 for a Request for Continued Examination Application (RCE) under 37 CFR 1.114(d) based on parent Application No. 09/892,878 is acceptable and a RCE has been established. An action on the RCE follows.

Information Disclosure Statement

No IDS have been filed to date in the instant Application.

Preliminary Amendment Status



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Acknowledgment is made of entry of the amendment after final filed 07 /29 /04 which was entered After the entry of the RCE request on 09/08/2004.

Therefore claims 1,11,15,17,19 and 21 as amended by the amendment entered on 09/08/04 and claims 3, 4, 12-14,16,18 and 20-21 as previously recited are currently pending in the Application.

Claims 2 and 5 to 10 have been previously cancelled.

AMENDMENT

The amendment entered on September 08, 2004 along with the RCE request, has been signed by only Mr. Qingyu Yin who has limited recognition under 37 CFR Section 10.9(b) till June 23, 2005.

As the application indicates that the Attorney of record is Ernest F. Chapman (25,961) and other Attorneys who have previously filed papers in this case and the Applicant is a client of the firm of Finnegan, Henderson and it is assumed that Mr. Qingyu , as required by his conditional recognition would have informed the USPTO of any change in his status as a lawful resident of U.S. and is currently employed by Finnegan, Henderson and further Mr. Qingyu Yin remains in U.S. on an H-1B visa thus complying with all the requirements of his limited recognition, the amendment is acceptable. In the event of any of Mr. Qingyu's conditional recognition conditions are not complied with the Office reserves the right to not accept the RCE request and the amendment.

Claim Rejections - 35 USC § 112

The following is a quotation of the first paragraph of 35 U.S.C. 112:

The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same and shall set forth the best mode contemplated by the inventor of carrying out his invention.

Claims 1,3-4 and 11-21 are rejected under 35 U.S.C. 112, first paragraph, as failing to comply with the written description requirement. The claim(s) contains subject matter which was not described in the specification in such a way as to reasonably convey to one skilled in the relevant art that the inventor(s), at the time the application was filed, had possession of the claimed invention.

The only independent claims (1 and 11) from which all dependent claims depend recite “ fine” gate. The adjective “ fine” to define the gate was not described in the specification in such a way as to reasonably convey to one skilled in the relevant art that the inventor(s), at the time the application was filed, had possession of the claimed invention.

Dependent claims 3-4 and 12-21 are at least rejected for depending upon rejected claims.

Applicants' may cancel the word" fine" if appropriate.

Appropriate correction is required.

Claim Rejections - 35 USC § 103

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The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

Claims 1,3-4, and 11-13, and 14-21 are rejected under 35 U.S.C. 103(a) as being unpatentable over Ye et al. (U.S. Patent No. 6,080,529 herein after Ye) in view of Lau et al. (U.S. Patent No. 5,173,542, herein after Lau). For response to Applicants' arguments see " response to arguments section" below.

With respect to claim 1 and 11 Ye describes a method of forming gate electrodes of a semiconductor device including the steps of: forming a gate insulation layer over the semiconductor wafer (Ye col. 11 lines 36-38, silicon dioxide layer not shown in the drawings), forming a conductive layer over the gate insulation layer (Ye fig. 2a # 216, col. 11 line 41), forming a low-dielectric layer over the conductive layer (Ye fig. 2A # 218, col. 11 line 42), forming a photo resist pattern whose width is equal to the exposure limit on the low dielectric layer (Ye layer 224 or 324, col. 21 lines 55-65, col. 22 lines 1-2 , col. 6 lines 5-21, especially line 18), patterning the low dielectric layer using the photo resist pattern as a mask (Fig. 2c , col. 6 lines 9- 18, col. 12 lines 28-32), removing photo resist pattern (col.11 lines 33-34), shrinking the low dielectric pattern.

Ye does not specifically mention shrinking the low dielectric pattern and the presently newly added limitation so that the shrunken low –dielectric pattern has a line width smaller than that of the photo resist pattern. (col. 10 lines 30-40 and figures)

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However, Lau, a patent from the same filed of endeavor (both Ye and Lau deal low dielectric layers made from organic polymers including PTFE, etc. see claim 3 of Ye and col. 1 lines 20-37 of Lau) describes the standard procedure of the shrinking the low-dielectric pattern by curing the low-dielectric pattern so that the shrunken low –dielectric pattern has a line width smaller than that of the photo resist pattern. (col. 10 lines 30-40 and figures) (Lau in col.14 line 37 and claim 11 © curing , similar to the Applicants' specification at least pages 6-7 para 16), to cross link the polymers.

Therefore it would have been obvious to one of ordinary skill in the art at the time of the invention to include Lau's curing (i.e. shrinking of dielectric) step so that the shrunken low –dielectric pattern has a line width smaller than that of the photo resist pattern in Ye's method steps to cross-link the polymer of the low dielectric layer . (Lau col. 1 lines 49-61).

The remaining limitations of claims 1 and 11.

Forming gate electrodes by patterning the conductive layer and the gate insulation layer using the shrunken low dielectric layer pattern as a mask (Figs. 3D and 2 B, col. 11 lines 66- col. 12 lines 32, col. 15 lines 6-10). (it is noted that Ye teaches at least two separate embodiments in figs. 2A—G and 3 A-G, however Ye in at least col. 15 lines 5-8 teaches the steps of embodiments in figs. 2 and 3 are interchangeably used).

It is noted that the order of performing the step of shrinking the low-dielectric pattern before/after removal of the photoresist pattern is different in claims 1 and 11.

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However, it is well settled law that the order of performing method steps is prima facie obvious. " As a matter of fact selection of any order of performing process steps is prima facie obvious in the absence of new or unexpected results. In *Re Burhaus*, 154 F.2d. 690,69 USPQ 330 (CCPA 1946). See also *Ex parte Rubin*, 126 USPQ 440 (BAPI 1959) and *In re Gibson*, 39 F.2d 975, 5 USPQ 230 (CCPA 1930).

Therefore irrespective of the order of performing the step/s the recited claims are prima facie obvious the applied prior art.

With respect to claim 2 wherein the low-dielectric layer is formed of an organic spin-on glass or inorganic spin-on glass layer. (Ye col. 6 lines 22-26-organic low k dielectric materials and col. 14 line 65-66 glass-like siloxane) .

With respect to claim 3 wherein the forming of the low –dielectric layer comprises : depositing low dielectric layer over the conductive layer for the gate electrodes (fig.2 G # 230, col. 13 lines 55-60) and soft –baking the low-dielectric layer at a predetermined temperature .

Ye does not specifically describe soft-baking its low-dielectric layer at a predetermined temperature.

However, Lau, a patent from the same filed of endeavor describes in col. 14 line 35 the standard procedure of soft –baking the low dielectric is soft baked after its application to drive off any remaining solvents from the mixture applied.

Therefore it would have been obvious to one of ordinary skill in the art at the time of the invention to include Lau standard " soft-baking step in Ye's method to remove any

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excess liquid remaining after the application of the dielectric polymer mixture on the wafer. (Lau col.14 Line 36).

With respect to claims 4 and 13 , wherein the shrinking the low-dielectric pattern by curing the low-dielectric pattern at 400-500 degrees centigrade. (Lau in col.14 line 37 and claim 11 © curing at 300-450 degrees to cross link the polymers). Therefore it would have been obvious to curing between 400-500 degrees without more because it was previously done in the over lapping range of 300-450 degrees.

With respect to claim 6, to the extent understood, it recites the same steps as claim 1 except for reciting, “ a material layer” instead of a “conductive layer “ in claim 1 and rejected for the same reasons as stated above under claim 1 . (It is noted that the sequence of performing the process steps is slightly changed in claim 6, however as well settled case law (Exparte Rubin and In re Burhaus , any order of performing steps is prima facie obvious in absence of new or unexpected results).

With respect to claim 12 wherein forming the low dielectric layer includes, depositing a low-dielectric layer over the conductive layer. (rejected for the same reasons as stated under claims 1 and 11 above).

With respect to claims 14,15,18 and 19 wherein the low-dielectric layer is formed on organic spin-on-glass like siloxanes or silicesquinoxanis .(Ye col. 14 line 64-66 , siloxane).

With respect to claims 16,17,20 and 21 wherein the low – dielectric layer is formed of inorganic spin-on-glass like silicate, hydrogen silicate or hydrogen silicesquinoxane. (Ye col. 10 lines 14,21,32-34, col. 14 lines 65-66, glass siloxane ,

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glass –known in the art as non-crystalline solids based on silica, silicon and silicates-
E.g.Chambers dictionary of Science and Technology199 ed. Page 510, etc.)

Response to Arguments

Applicant's arguments filed September 08, 2004 have been fully considered but they are not persuasive for the following reasons :

It is noted that Applicants' arguments are based on piece meal attacks on references, it has been held that one cannot show non-obviousness by attacking references individually where, as here, the rejections are based on combinations of references. In re Keller, 208 USPQ 871 (CCPA 1981).

Applicants' first contention that Lau does not teach or suggest shrinking a low dielectric pattern because cross linking is not necessarily the same as shrinking because not every low dielectric film shrinks when cured for cross linking citing SILKTM H as an example of low K dielectric that allegedly does not shrink during curing is not persuasive because :

(a) Applicants' attempt to limit Lau's teachings to curing step as being performed in the formation of the low-dieltric layer rather after formation is base on incomplete understanding of Lau's process. Lau similar to Applicant's specification and claims forms the low-k dielectric and then performing the last curing step to cross link.

(b) Applicants' have provided no evidence why they conclude, " Silk does shrink when cured for cross linking " therefore very little or no probative value can be given to this conclusion.

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(c) Applicants' by attempting to limit the teachings of Ye to "Silk" only are stating an incomplete list of materials taught by Ye. In fact Ye in col. 23 lines 5 to 20 lists several materials including SILK, FLARE and

tric materials such as SILK™, an organic polymer similar to BCB (divinylsiloxane bis-benzocyclobutene), which does not contain silicon, available from Dow Chemical Co., Midland, Mich.; FLARE 2.0™, a poly(arylene ether) available from Allied Signal Advanced Microelectronic Materials, Sunnyvale, Calif., which does not contain fluorine, despite its name. Although SILK™, and FLARE 2.0™ have been determined to work well, there are numerous other low k dielectric materials which are expected to behave in a similar manner when etched in accordance with the method of the present invention, using the etch chemistry described herein. Preferably these other low k dielectric materials do not include silicon or fluorine. Other non-fluorine-containing low k dielectrics include poly(arylene) ethers; Poly(arylene)ether oxazoles; Parylene-N; Polyimides; Polynaphthalene-N; Polyphenyl-Quinoxalines (PPQ); Polybenzoxazoles; Polyindane; Polynorbornene; Polystyrene; Polyphenyleneoxide; Polyethylene; Polypropylene; and similar materials.

Therefore even assuming Applicants' conclusion regarding the non-shrinkage of the Silk is true (which is not conceded by the Office) Ye teachings of the several other materials including a plurality of materials that shrink when cured is sufficient to overcome Applicants' conclusion based on incomplete teachings of the materials taught by YE.

Applicants' next contention that neither Ye nor Lau teaches or suggests removing a photo resist pattern and shrinking a low -dielectric pattern at the same time misses the current case law In re Tatincloux 108 USPQ 125 (CCPA 1955) which states , " The performance of two steps simultaneously , which have previously been performed in sequence was held to have been obvious. "

Applicants' contention that Ye and Lau cannot be combined because there is no suggestion or motivation either in Ye and Lau themselves or the knowledge available to

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one of ordinary skill in the art because the nature of the problem to be solved in the claimed invention is forming fine patterns of a semiconductor device by shrinking a low dielectric pattern and neither Ye or Lau is directed to forming fine patterns of a semiconductor device is not persuasive because both Ye and Lau are directed to forming patterns , further none of the claims presently recite “ fine”.

Secondly current case law as stated by In re Gershon, 152 USPQ 602(CCPA1967) is that the mere fact that the references relied upon by the Office fail to evidence an appreciation of the problem identified and solved by the applicant is not standing alone , conclusive evidence of the nonobviousness of the claimed subject matter.

Applicants' next contention that here is no motivation to combine Ye and Lau is baseless because the motivation (which has been provided all along the prosecution) and reproduced here :

“Therefore it would have been obvious to one of ordinary skill in the art at the time of the invention to include Lau's curing (i.e. shrinking of dielectric) step so that the shrunken low –dielectric pattern has a line width smaller than that of the photo resist pattern in Ye's method steps to cross-link the polymer of the low dielectric layer . (Lau col. 1 lines 49-61).”

Applicants' next contention that there is no reasonable expectation of success of the combination because there is no evidence in Ye or Lau suggesting modification would be successful is not persuasive because (as stated in the rejection)

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Therefore it would have been obvious to one of ordinary skill in the art at the time of the invention to include Lau's curing (i.e. shrinking of dielectric) step in Ye's method steps to cross-link the polymer of the low dielectric layer . (Lau col. 1 lines 49-61).

Applicants' contention that Lau characterization of its polymer film as a barrier layer does not magically make ins inherent dielectric properties disappear.

Applicants' next contention that Ye (USP 6,080,529) in col.8 lines 32-34 require the barrier layer to " about 500 Angstrom thick" is not understood because reproduced in col. Portion of col8 including lines 32-34 which has nothing to do how thick the barrier layer is and the only response possible is that Applicants' arguments are not persuasive.

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FIG. 2A shows a schematic of the cross-sectional view of a first preferred embodiment plasma etch stack of the present invention. FIGS. 2B through 2G show the changes in the etch stack as it progresses through the method steps of the present invention.

FIG. 3A shows a schematic of the cross-sectional view of a second preferred embodiment plasma etch stack of the present invention. FIGS. 3B through 3G show the changes in the etch stack as it progresses through the method steps of the present invention.

FIG. 4A shows a schematic of a cross-sectional view of a series of etched contact vias, where each via is created through a multilayered structure which includes, from top to bottom, a layer of silicon oxide patterned hard mask, and a layer of FLARE™ low dielectric constant material. Underlying the low k dielectric is a layer of titanium nitride, and underlying the titanium nitride is a layer of aluminum. Due to the etch chemistry used to etch the via, the low k dielectric, a poly(arylene ether) is severely undercut beneath the patterning silicon oxide hard mask.

FIG. 4B shows a schematic of a cross-sectional view of the same etched contact vias shown in FIG. 4A, except that the etch chemistry of the present invention was used to provide nearly straight sidewalls on the etched via.

FIG. 5 is a schematic of a process chamber and auxiliary apparatus of the kind which can be used to carry out the plasma etching steps described herein.

FIG. 6 is a schematic of a processing system which includes a variety of process chambers which permit transfer of substrates from one chamber to another under a controlled environment. For example, the substrate is not exposed to air or moisture.

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Further the inclusion of Lau's curing in Ye' method will be successful in producing a cross linked low dielectric layer.

Therefore all of Applicant's arguments with respect to claims 1 and 11 are not persuasive and claims 1 and 11 are not allowable.


Dependent claims 3, 4 and 12-21 were alleged to be allowable because they depend from allegedly allowable claims 1 and 11.

However as shown above claims 1 and 11 are not allowable and therefore claims 3,4 and 12-21 are also not allowable.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Steven H. Rao whose telephone number is (571) 272-1718 . The examiner can normally be reached on 8.00 to 5.00.

The fax phone numbers for the organization where this application or proceeding is assigned are (703) 746 -3926 for regular communications and (703) 872-9319 for After Final communications.


Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is (703) 3067722.



Steven H. Rao

Patent Examiner

October 15, 2004.



PHAT X. CAO
PRIMARY EXAMINER